



Environmental Justice & Climate Change in Wichita, Kansas



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NASA DEVELOP Virtual Environmental Justice Node – Wichita Climate

Melissa Ashbaugh, Muskaan Khemani, Brooke Laird, and Sadie Murray

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The City of Wichita and the NASA DEVELOP Wichita Climate team are excited to present this resource for residents, planners, and community organizations to visualize the way that heat will impact

Wichita and to explore the relationship between heat, trees, and environmental justice.



Extreme heat is an issue that Wichita's residents are facing as the effects of climate change increase in scale and frequency. In 2021, Wichita had more than 12 days with temperatures above 100° F.

Image Credit: City of Wichita



As extreme heat worsens, certain communities and neighborhoods feel the effects more than others. Differences in temperature are often related to resource allocation and zoning, disproportionately impacting marginalized groups.

Image Credit: City of Wichita



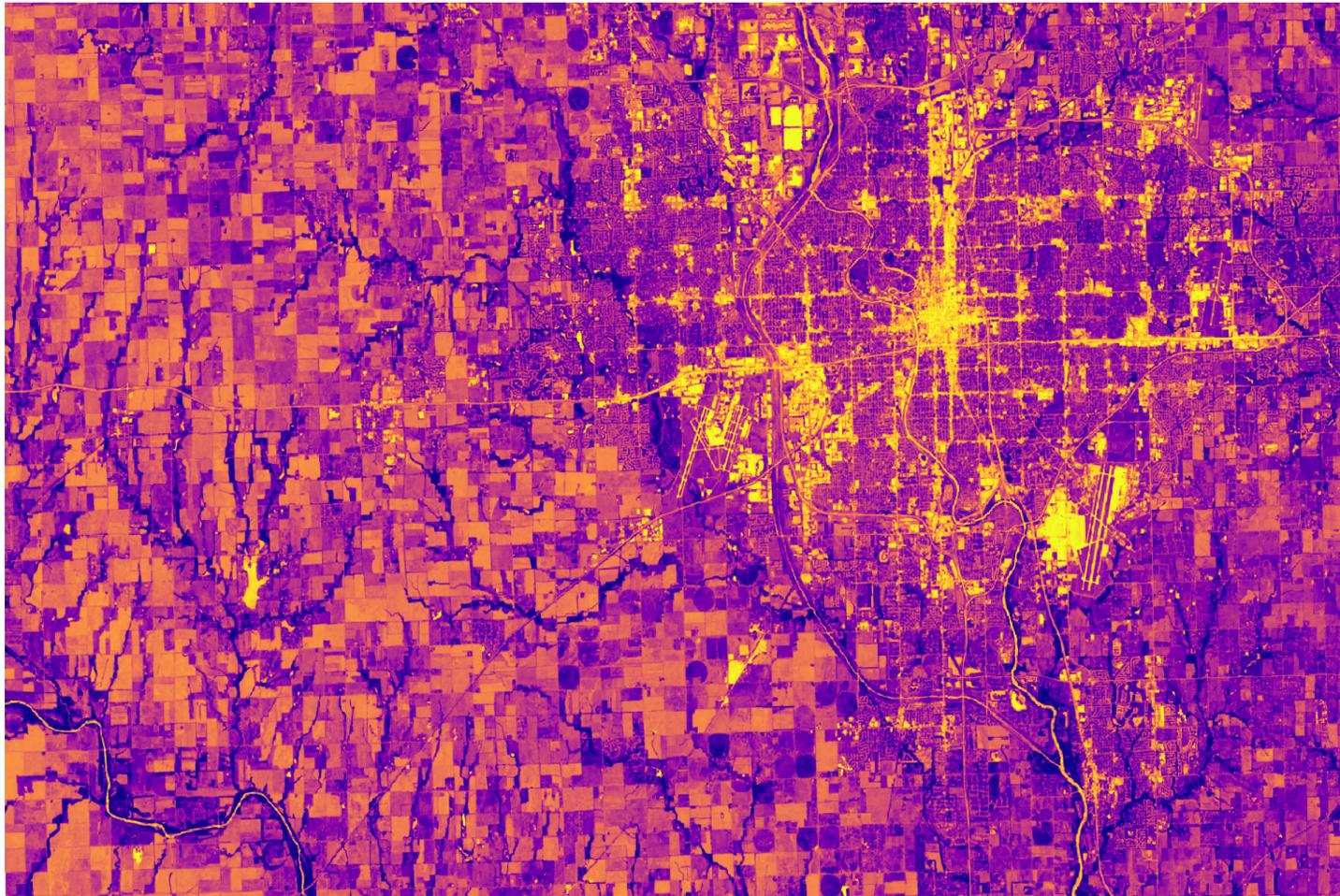
In this project, we explore the relationship between various factors that influence how people experience heat.

Wichita is predominantly White, followed by Black/African American and Latino/Hispanic populations. The median income of a household in Wichita is \$53,000, which is almost \$10,000 less than the national average.

Image Credit: City of Wichita

Heat risk is deeply connected with environmental justice because the effects of climate change are not evenly distributed and impact different parts of the population in unique ways. Heat risk is a combination of heat exposure (which areas are hotter) and heat vulnerability (which populations are most likely to suffer negative impacts from heat). Previous research has found that vulnerable communities (which can be defined by factors including race, income, age, sexual orientation, gender, education-level, country of birth) are often faced with the worst effects of climate change.

As a concept, environmental justice addresses the inequitable distribution of environmental benefits and negative impacts. In action, it calls for meaningful engagement with those most impacted.



The City of Wichita and the NASA DEVELOP program collaborated to explore how Earth observations could be integrated into Wichita's geospatial analysis and decision-making. We used Landsat 8 OLI/TIRS, Aqua MODIS, and PlanetScope Earth observations. DEVELOP, part of NASA's Earth Applied Sciences Program, aims to address community concerns and support informed decision-making using Earth observation data. DEVELOP conducts studies during 10-week terms, where teams work with community partners, to support their geospatial needs. This project was conducted by

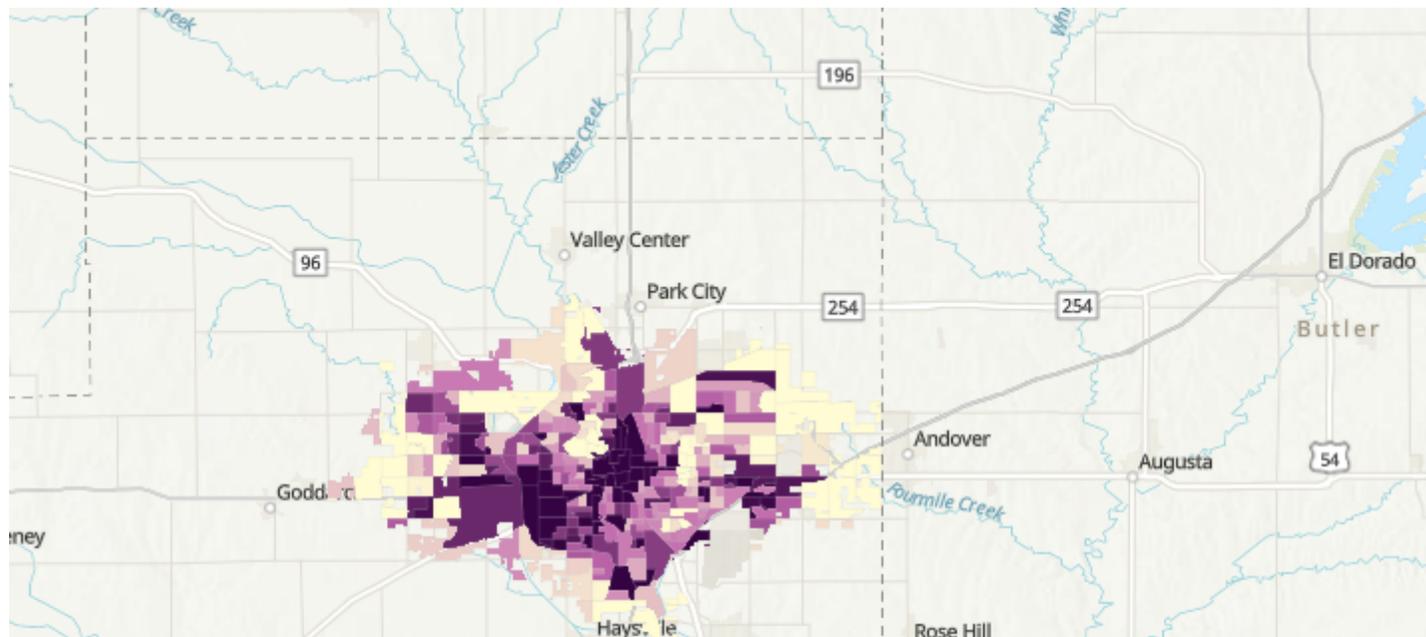
DEVELOP's Virtual Environmental Justice node, which began in [2021](#).

Image Credit: Wichita Climate Team Summer 2022

Community Concerns

The City of Wichita is in the process of developing its **Climate Adaptation and Mitigation Plan** to make the city more resilient to the effects of climate change and dedicate resources to vulnerable communities. We envision a future where Wichita balances economic vitality and environmental quality. To do so, we will need to ensure that the **burdens of extreme heat** and the **benefits of tree canopy** are **distributed equitably** across Wichita.

Climate Change & Heat Exposure



Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Ri... Powered by Esri

Figure 1. Daytime Temperature

Daytime temperatures are hotter in the city center and southwestern Wichita. As you move away from the city center, heat exposure generally decreases.

Still, extreme heat is a concern for all of Wichita. From 2013-2021, the average summer temperature was 88° F, and the average temperatures were at least 80° F throughout the city.

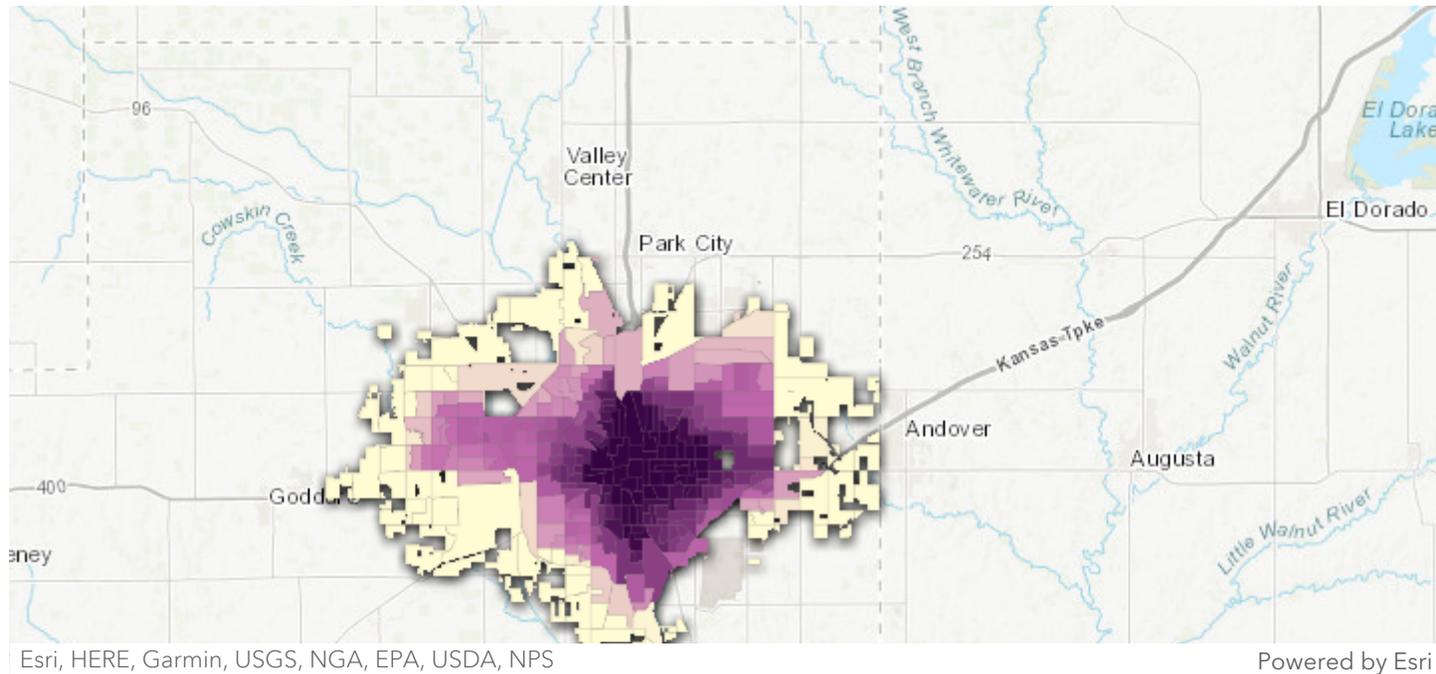


Figure 2. Nighttime Temperature

Nighttime heat exposure in Wichita is highest in the city center, and it decreases with distance from the city center. The geographic concentration of nighttime heat in the city center indicates buildings may be retaining substantial heat at night.

Nighttime temperature was calculated at a different scale than daytime temperature (1 km vs 30 m), reducing the precision of nighttime temperature calculations.

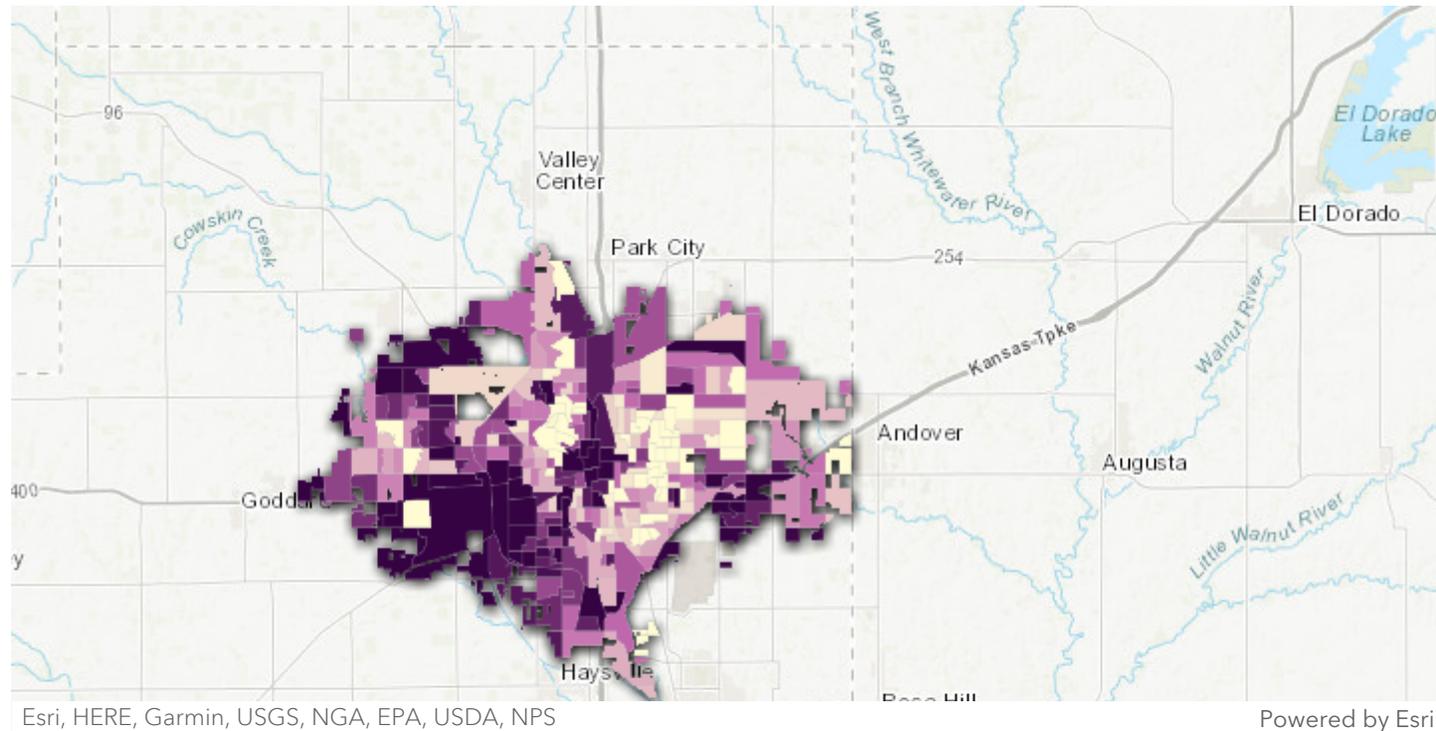


Figure 3. Change in Temperature

Analyzing changes in temperature between daytime and nighttime is important for identifying where extreme heat continues to linger.

The areas shown in dark purple retain much of their heat going into the night. This also means that neighborhoods with some of the hottest daytime temperatures do not cool below 70° F at night. These areas remain exposed to extreme heat.

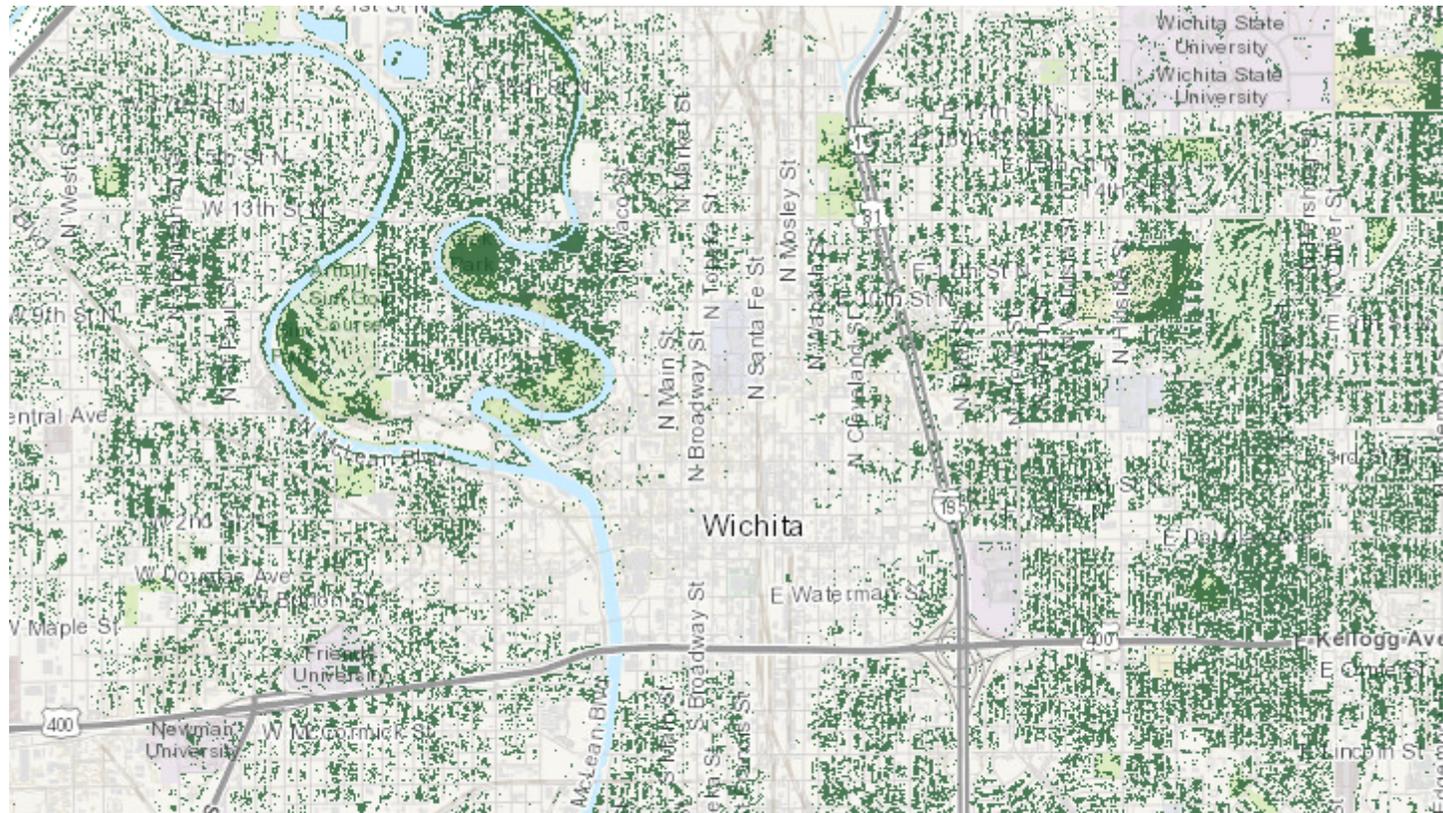
Heat exposure can exacerbate any pre-existing health conditions and can have a number of negative health consequences, including death. It can negatively affect reproduction, work capacity, cognitive processing, and mental health. Long-term health

consequences of chronic heat exposure include damage to the heart, blood, stomach, and intestines. Exposure to extreme heat creates a substantial financial burden on healthcare systems, one that is felt most heavily by women, the elderly, low-income families, and minority groups.

Current Mitigation Strategy: Tree Canopy Cover

A common strategy to decrease urban heat risk is planting trees. Increased canopy cover allows for greater shade, improved air quality, and heat mitigation. It also can reduce electricity bills and energy demands on the city. Despite these benefits, the city of Wichita has experienced a decrease in urban canopy cover over the past five years due to factors including urbanization and tree die-off. To develop and implement climate mitigation strategies, urban tree planting efforts will be essential for combatting extreme urban heat and equitably rebuilding tree canopy loss.

By identifying urban tree canopy in Wichita, we can better identify which neighborhoods are in need of tree planting efforts. Providing data to adequately determine priority areas leads to efficient use of time, funding, and tree planting efforts.



City of Wichita, Sedgwick County, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS, METI/NASA, NGA, EPA, U... Powered by Esri

Figure 4. Tree Canopy Cover

Move around the map to see where trees have been detected.

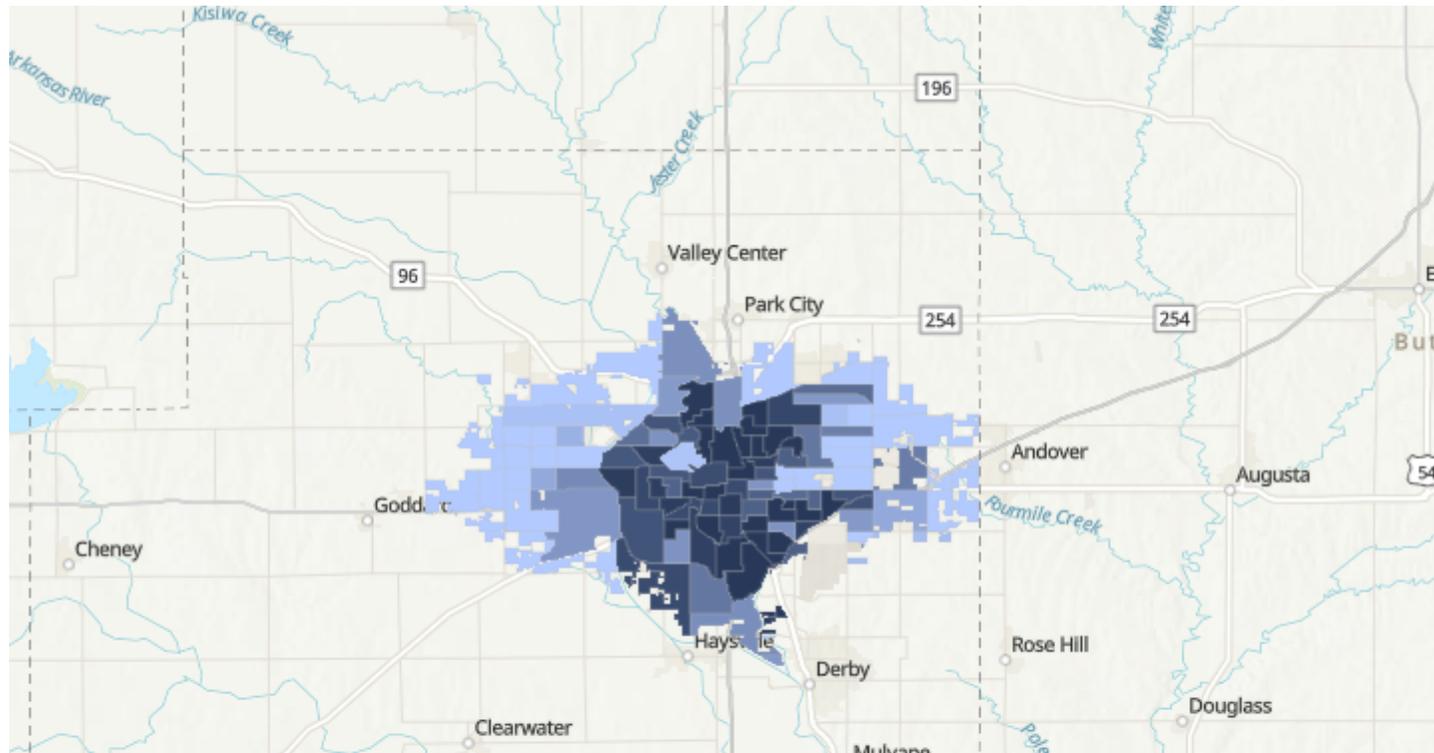
The amount of tree canopy varies significantly across different parts of Wichita. While the central districts of the city face the highest temperatures, these areas have low amounts of tree canopy to protect against the heat. Future tree planting efforts will be most impactful in communities with low levels of tree canopy.

Situating the People: Heat Vulnerability & Heat Risk

When extreme heat hits, not everyone suffers the same consequences. For example, someone in a hot area might have access to air conditioning, while another person might have a limited electricity budget to cool their home or an underlying health condition that worsens with heat. **Vulnerability** describes how negative consequences can vary.

To estimate vulnerability we used the Centers for Disease Control (CDC) Social Vulnerability Index. The index combines census data on socioeconomic status, household composition and disability, minority status and language, and housing type and transportation to assign a vulnerability score from 0-1 for each census tract. We also looked at data from the Climate and Economic Justice Screening Tool, which identifies disadvantaged census tracts based on environmental and climate indicators as well as socioeconomic status.

Vulnerability is **high in central Wichita** and **lowest on the western and eastern edges** of the city. To view more details on vulnerability, including health, income, and racial demographics click on a census tract in the vulnerability map.



Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Ri... Powered by Esri

Figure 5.

Vulnerability, defined by the CDC's Social Vulnerability Index, is high in central Wichita and lowest on the western and eastern edges of the city. Unless additional resources are provided, areas of high vulnerability are likely to suffer the worst consequences from heat.

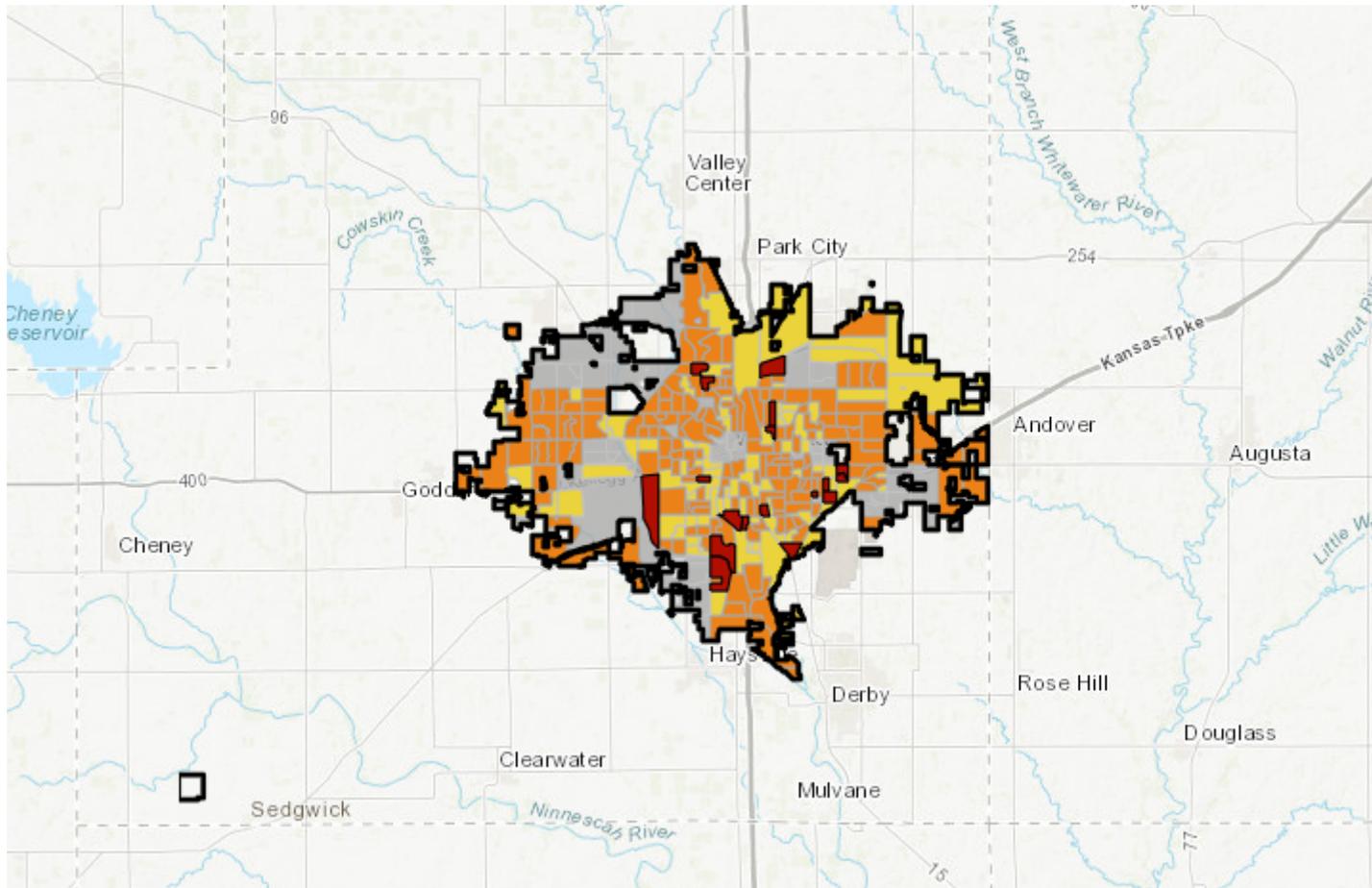
To define priority areas, we combined heat exposure (which areas are hotter) and vulnerability (which populations are most likely to suffer negative impacts from heat) into a heat risk score. We identified **17 high risk census tracts**, which experience the highest average temperature and are extremely socially vulnerable. These census tracts mostly circle the city center. Of those, 82% are also

identified as environmentally disadvantaged by Climate and Economic Justice Screening Tool, meaning projects in these areas are eligible to contribute to Justice40 goals of providing 40% of the benefits from Federal programs to disadvantaged communities. You can explore this further in **Figure 6**, below.

We also created a risk score based on three variables: % low-income, % non-white, and % above age 65. Based on analysis, we found that income has the most significant relationship with heat risk. Lower-income communities face higher heat risk. **Figure 7** shows these relationships further.



Figure 6. Heat risk, defined by average summer temperature and the CDC Social Vulnerability Index, is highest in census tracts circling the city center. Future heat mitigation efforts, such as tree planting and maintenance, cooling center siting, and targeted programs to manage energy burden can focus on these highest risk census tracts.



Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Powered by Esri

Figure 7. The map above shows areas of Wichita with high heat risk that we created based on income, race/ethnicity, and age.

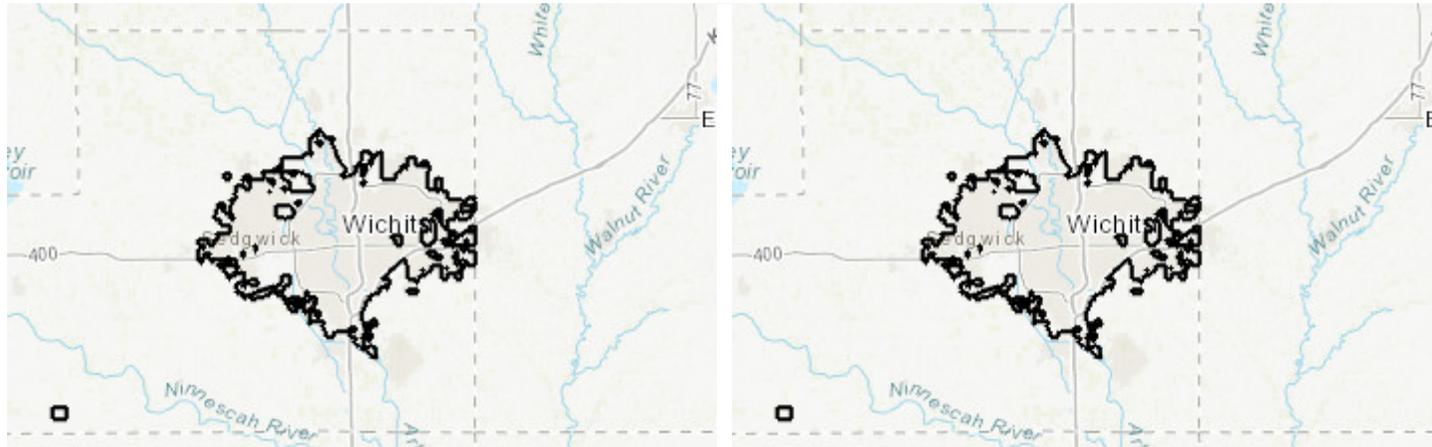
Areas not filled in have no data.

Situating the People: Zoning Laws Historically and Today

Using high resolution satellite imagery allows estimates of surface temperature and tree canopy cover to expand beyond city level estimates. By analyzing differences at the block group level, it is evident that the impacts of extreme heat are not felt equally among different communities. Many vulnerable communities have been shaped by historic housing policies and zoning practices, dating back a number of decades.

In the 1930s, certain communities were denied homeownership loans in a practice that is known today as "redlining". The Home Owners Loan Corporation (HOLC) created maps that designated which areas were most desirable, basing this decision on socioeconomic factors like race. The inequities brought about by this policy continue to impact vulnerable communities today. Below is a map of historically redlined neighborhoods in Wichita compared to socially vulnerable areas in Wichita that have high heat exposure today. It is evident that **historically redlined communities** in Wichita are **now facing problems of heat burden and injustice**.

Additionally, historically unequal distribution of resources means that many vulnerable communities are further from public green space or recreational areas. Access to green space is an essential component of heat mitigation and public health.



Esri, HERE, Garmin, FAO, USGS, NGA, EPA,... Powered by Esri Esri, HERE, Garmin, FAO, USGS, NGA, EPA,... Powered by Esri

The left map shows the historical areas that were redlined (Green = Best, Blue = Still Desirable, Yellow = Declining, Red = Hazardous). The right map shows heat exposure (darker red areas indicate high daytime temperatures and darker blue areas indicate low daytime temperatures). Click on specific block groups for more information on heat vulnerability and heat risk.

Now What? Solutions Forward!

City officials and residents can use this StoryMap to inform their mitigation practices and reduce heat risk through targeted interventions. Actions that can help reduce heat risk include increased tree planting efforts, educational campaigns on preventing heat-related illness, and availability of cooling centers.

Furthermore, the dangers of extreme heat can impact individuals during a commute to work or school and during hot work days in outdoor environments. Heat mitigation efforts must support vulnerable populations in both indoor and outdoor spaces.

Even though initiatives and policies to increase tree canopy coverage can help mitigate extreme heat effects on communities in Wichita, city officials and community leaders will have the complex job of assessing all potential outcomes from these actions. Green gentrification occurs when environmental greening leads to increased property values and often pushes out lower-income residents the policies were aimed to benefit.

The principles of environmental justice underlying this StoryMap speak to the importance of community engagement, equality of voices, responsible use of land, and respect for the sovereignty of Native Peoples, among others. These maps serve as a starting point for city officials and community leaders to equitably increase tree canopy cover and inform other heat mitigation practices.

Acknowledgements

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- Partner - Nina Rasmussen (City of Wichita)
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- Assistant Fellow - Remi Work (NASA DEVELOP)

The DEVELOP team would like to acknowledge that our engagement with the whole Wichita community was limited to the City of Wichita. In future continuations of this project, we hope that we can engage more members of the community to make this research widely applicable and more locally accurate.

Additional Resources

1. [City of Wichita Local Government Page](#), for government related information, resources, and information
2. [City of Wichita GIS](#), a source of public geospatial information about Wichita
3. [WSU: Environmental Justice 101](#), an intro to environmental justice course description and information from Wichita State University
4. [Sunrise Wichita](#), a youth-led movement working on climate justice, economic vitality, and building up locally

5. [Kansas Youth for Climate Justice](#), a youth-led movement in Kansas fighting for intersectional climate justice
6. [Canopy ICT](#), a community-based group working towards increasing Wichita's tree canopy
7. Wichita Beacon's [report](#) on unpaved roads
8. [EJScreen](#), the EPA's environmental justice screening and mapping tool
9. Climate & Economic Justice [screening tool](#)
10. [Public GIS Resources](#) for Kansas

Please reach out to Brooke Laird by email at brookelaird10@gmail.com if you have additional resources that you would like us to share regarding environmental justice, urban heat, tree canopy, climate issues, or mapping resources.

References

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The Effects of Historical
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